

**What is Claimed:**

1. A transgenic organism that produces vanillin when provided with caffeic acid or an esterified derivative thereof, the organism comprising expressible transgenes encoding:

5 a) a 3-O-methyltransferase that catalyzes methylation of caffeic acid to form ferulic acid; and

b) a chain-shortening enzyme that non-oxidatively converts ferulic acid to vanillin.

2. The organism of claim 1, which contains an endogenous esterase that hydrolyzes esters of caffeic acid.

10 3. The organism of claim 1, which further comprises an expressible transgene encoding an esterase that hydrolyzes esters of caffeic acid.

4. The organism of claim 1, which is a procaryote.

5. The organism of claim 4, which is *Escherichia coli* or *Pseudomonas spp.*

6. The organism of claim 1, which is a eucaryote.

7. The organism of claim 6, which is *Pichia pastoris* or *Saccharomyces cerevisiae*.

15 8. The organism of claim 1, wherein the 3-O-methyltransferase is from a plant source.

9. The organism of claim 8, wherein the plant source is selected from the group consisting of *Catharanthus roseus*, *Clarkia breweri*, *Coffea canephora*, *Eucalyptus gunnii*, *Festuca arundinacea*, *Hordeum vulgare*, *Lolium perenne*, *Medicago sativa*, *Nicotiana tabacum*, *Ocimum basilicum*, *Populus tremuloides*, *Prunus amygdalus*, *Saccharum officinarum*,  
20 *Sorghum bicolor*, *Thalictrum tuberosum*, *Triticum aestivum*, *Vanilla planifolia* and *Zea mays*.

10. The organism of claim 9, wherein the 3-O-methyltransferase is from *Vanilla planifolia*.

11. The organism of claim 1, wherein the chain-shortening enzyme is from a plant source.



12. The organism of claim 11, comprising a 4-hydroxybenzaldehyde synthase from *Vanilla planifolia*.

13. The organism of claim 1, wherein the chain shortening enzyme is from a bacterial source.

5 14. The organism of claim 13, comprising enoyl-SCoA hydratase/lyase.

15. A method for producing vanillin, which comprises:

a) providing a transgenic organism that produces vanillin when provided with caffeic acid or an esterified derivative thereof, the organism comprising expressible transgenes encoding:

10 i) a 3-O-methyltransferase that catalyzes methylation of caffeic acid to form ferulic acid; and

ii) a chain-shortening enzyme that non-oxidatively converts ferulic acid to vanillin;

15 b) culturing the transgenic organism in the presence of the caffeic acid or esterified derivative thereof, under conditions whereby the transgenic organism produces vanillin; and

c) recovering the vanillin from the culture.

16. The method of claim 15, wherein the organism contains an endogenous esterase that hydrolyzes esters of caffeic acid.

20 17. The method of claim 15, wherein the organism comprises an expressible transgene encoding an esterase that hydrolyzes esters of caffeic acid.

18. The method of claim 15, wherein the organism is a procaryote.

19. The method of claim 18, wherein the organism is *Escherichia coli* or *Pseudomonas spp.*

20. The method of claim 15, wherein the organism is a eucaryote.

25 21. The method of claim 20, wherein the organism is *Pichia pastoris* or *Saccharomyces cerevisiae*.



22. The method of claim 15, wherein the organism comprises a 3-O-methyltransferase from a plant source.

23. The method of claim 22, wherein the plant source is selected from the group consisting of *Catharanthus roseus*, *Clarkia breweri*, *Coffea canephora*, *Eucalyptus gunnii*, *Festuca arundinacea*, *Hordeum vulgare*, *Lolium perenne*, *Medicago sativa*, *Nicotiana tabacum*,  
5 *Ocimum basilicum*, *Populus tremuloides*, *Prunus amygdalus*, *Saccharum officinarum*, *Sorghum bicolor*, *Thalictrum tuberosum*, *Triticum aestivum*, *Vanilla planifolia* and *Zea mays*.

24. The method of claim 9, wherein the organism comprises 3-O-methyltransferase from *Vanilla planifolia*.

10 25. The method of claim 15, wherein the organism comprises a chain-shortening enzyme from a plant source.

26. The method of claim 25, wherein the organism comprises a 4-hydroxybenzaldehyde synthase from *Vanilla planifolia*.

15 28. The method of claim 15, wherein the organism comprises a chain shortening enzyme from a bacterial source.

29. The method of claim 28, wherein the organism comprises enoyl-SCoA hydratase/lyase.

30. The method of claim 15, comprising providing the organism with caffeic acid.

32. The method of claim 15, comprising providing the organism with a caffeic acid ester.

20 33. The method of claim 33, wherein the caffeic acid ester is one or more of cichoric acid, rosmarinic acid, chlorogenic acid, 1-caffeoylquinic acid or 1,5-dicaffeoylquinic acid.

34. An O-methyltransferase from *Vanilla planifolia* that catalyzes methylation of substrates selected from the group consisting of 5-OH-ferulic acid ethyl ester, caffeic acid ethyl ester, caffeoyl aldehyde, 5-OH-coniferaldehyde, 5-OH-ferulic acid, 3,4-dihydroxybenzaldehyde and caffeic acid.



35. The O-methyltransferase of claim 34, having an amino acid sequence at least 90% identical to SEQ ID NO:2.
36. The O-methyltransferase of claim 35, comprising amino acid SEQ ID NO:2.
37. An isolated nucleic acid molecule that encodes the O-methyltransferase of claim 34.
- 5 38. The isolated nucleic acid molecule of claim 37, which encodes a polypeptide having an amino acid sequence at least 90% identical to SEQ ID NO:2.
39. The isolated nucleic acid molecule of claim 38, which encodes a polypeptide having SEQ ID NO:2.
40. The isolated nucleic acid molecule of claim 39, having a sequence of SEQ ID NO:1.